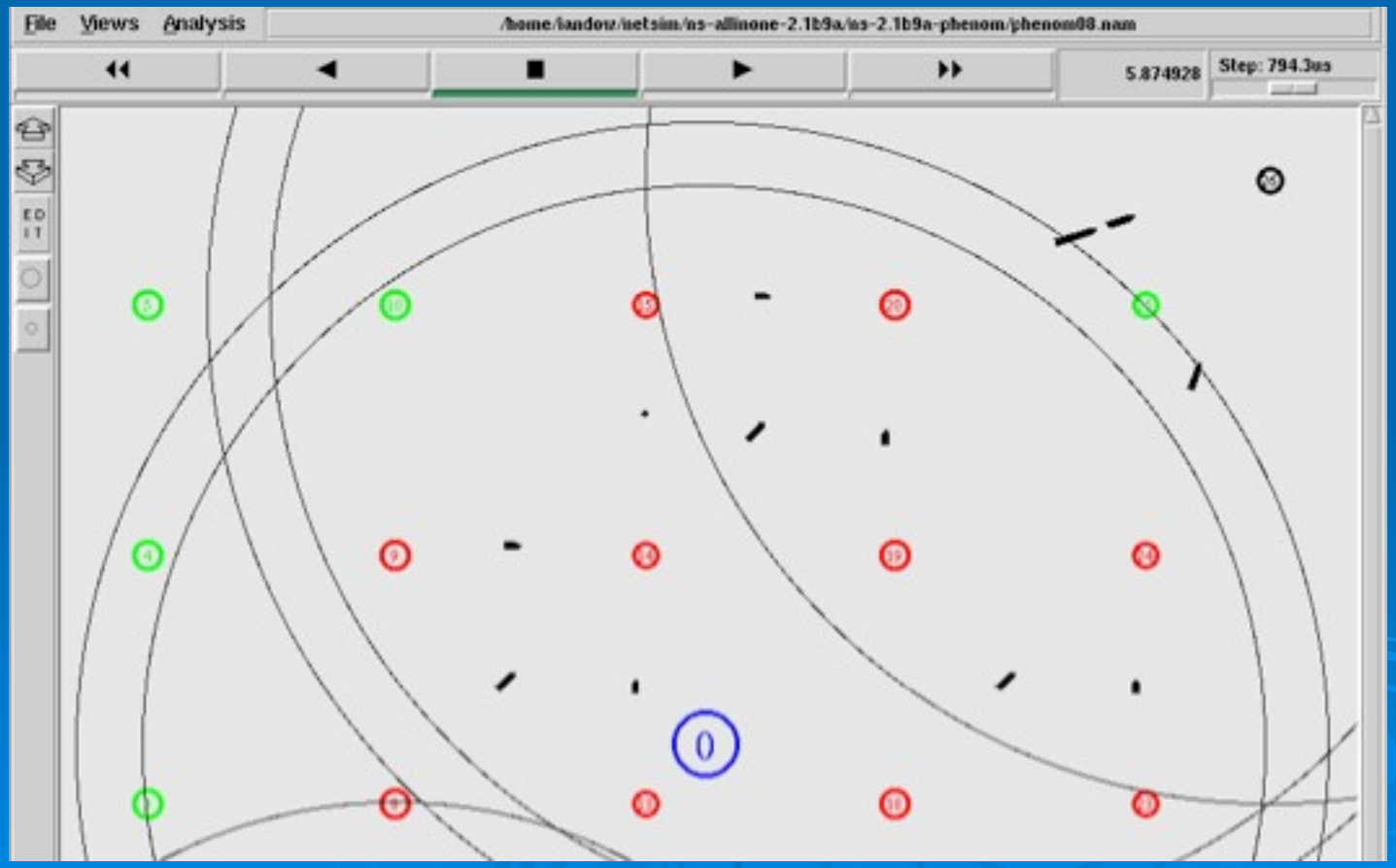
Sensornets with ns2



Features

- Leveraged existing support for mobile nodes
- Simulations can include multiple phenomena
- Energy model extended to support sensor nodes (i.e. sensing costs energy)
- Node colors used to identify alarming sensors in nam

Sample Simulations

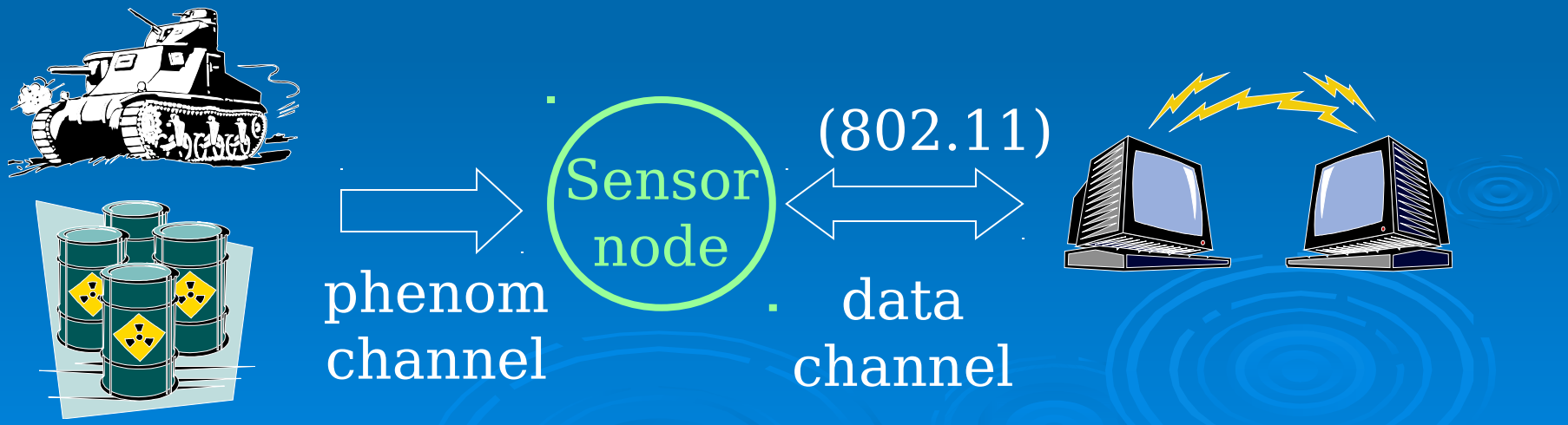
- Small-scale sensor network with multiple phenomena (4 nodes)
- Moderate-scale sensor network (26 nodes)
- Moderate-scale sensor network with energy constraints

Howto configure a sensor network simulation

1. Configure separate channels for phenomena and data
2. Create phenomenon nodes
3. Create sensor nodes
4. Create non-sensor nodes
5. Attach sensor agents to sensor nodes
6. Attach UDP agent and sensor application to sensor nodes
7. Start sensor applications

Configure separate channels

```
set chan_phenom [new $val(chan)]
set chan_data_ [new $val(chan)]
```



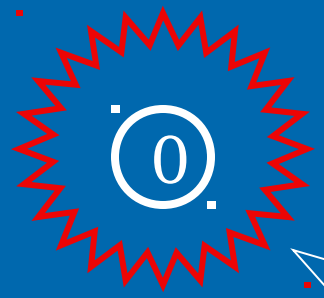
Create Phenomenon node

0

```
$ns_ node-config \
  -adhocRouting PHENOM \
  -channel $chan_phenom \
  -llType $val(ll) \
  -macType $val(mac) \
  -ifqType $val(ifq) \
  -ifqLen $val(ifqlen) \
  -antType $val(ant) \
  -propType $val(prop) \
  -phyType $val(netif) \
  -topoInstance $topo \
  -agentTrace ON \
  -routerTrace ON \
  -macTrace ON \
  …
```

Same parameter are used to configure any mobile node.

Configure phenomenon



Phenomenon type:

“I am shaking the ground!”
“I am Carbon Monoxide!”
“I am loud!”
“I am generic phenomenon.”

Pulse rate:

10x / sec

```
[$node_(0) set ragent_] pulserate .1   ;# emanate 10x / sec
[$node_(0) set ragent_] phenomenon CO  ;# represent CO gas
```

Create Sensor node

1

```
$ns_ node-config \
  -adhocRouting $val(rp) \
  -channel $chan_data \
  -PHENOMchannel $chan_phenom \
  -energyModel $val(engmodel) \
  -rxPower $val(rxPower) \
  -txPower $val(txPower) \
  -sensePower $val(sensePower) \
  -idlePower $val(idlePower) \
  -initialEnergy $val(initeng) \
  -llType $val(ll) \
  -macType $val(mac) \
  …
```

Energy mode parameters are optional.

Create non-sensor nodes

- Data collection points
- Gateways

2

```
$ns_ node-config \
  -adhocRouting $val(rp) \
  -channel $chan_data \
  -PHENOMchannel “off” \
  -llType $val(ll) \
  -macType $val(mac) \
  …
```

Howto configure a sensor network simulation

- ✓ Configure separate channels for phenomena and data
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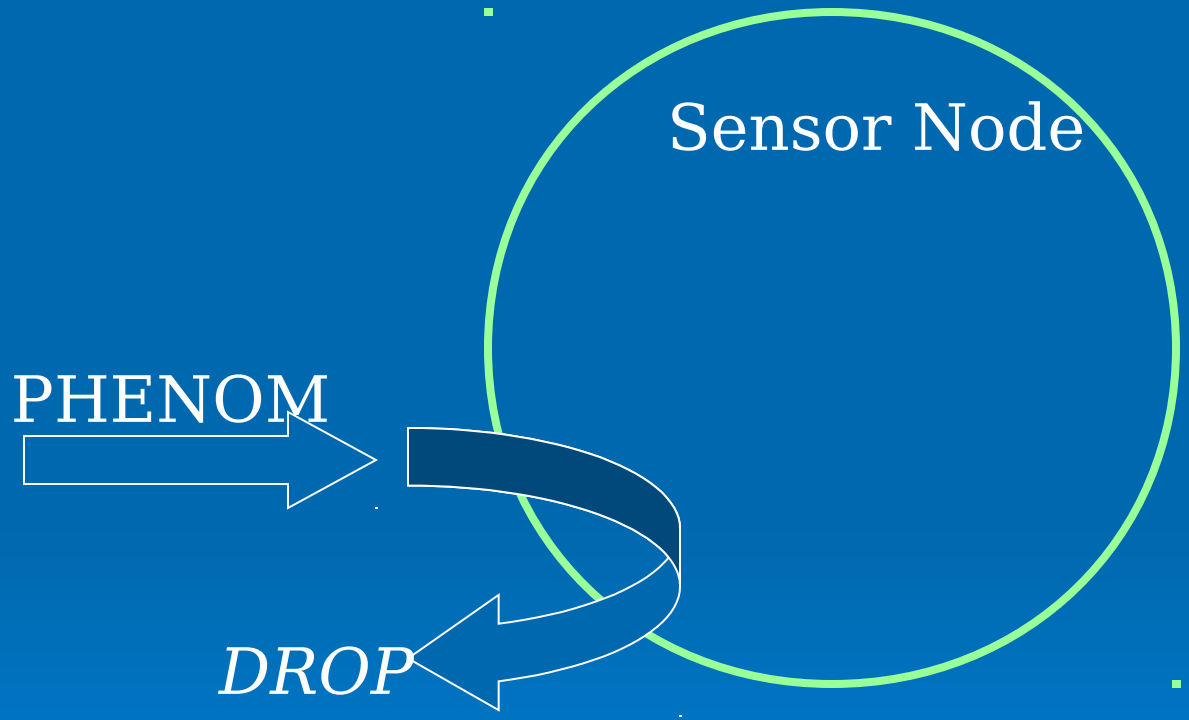
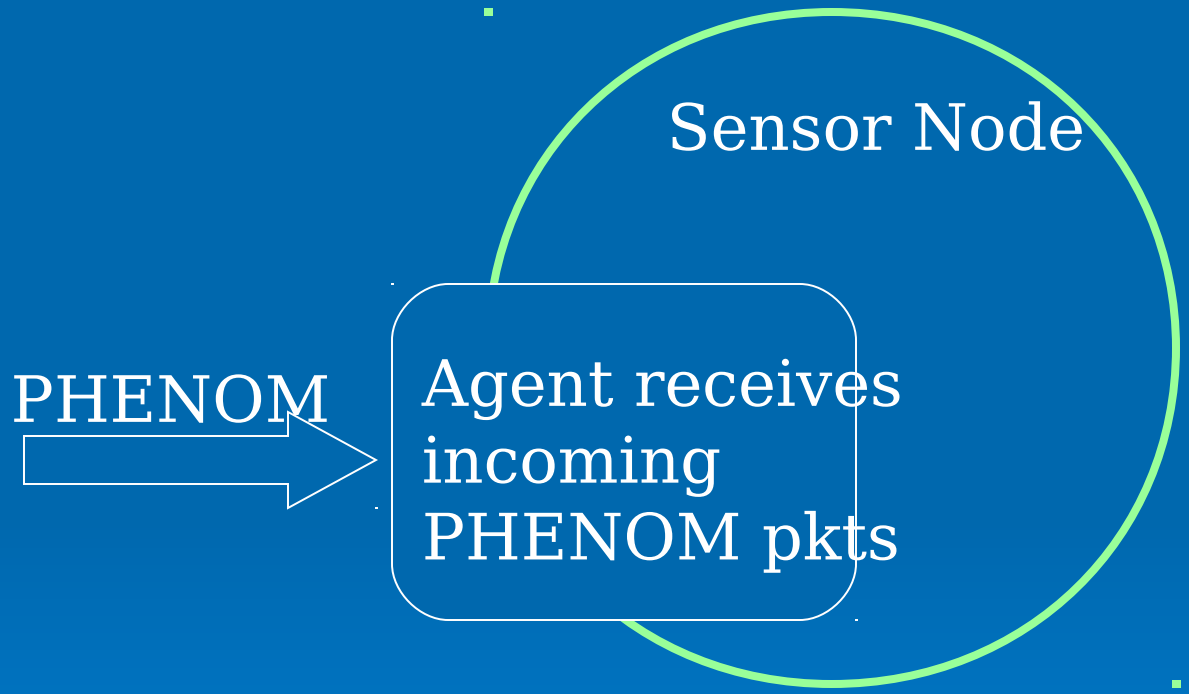
- ✓ Create non-sensor nodes
- • Attach sensor agents to sensor nodes
- • Attach UDP agent and sensor application to sensor nodes
- • Start sensor applications

Attach sensor Agent to sensor node

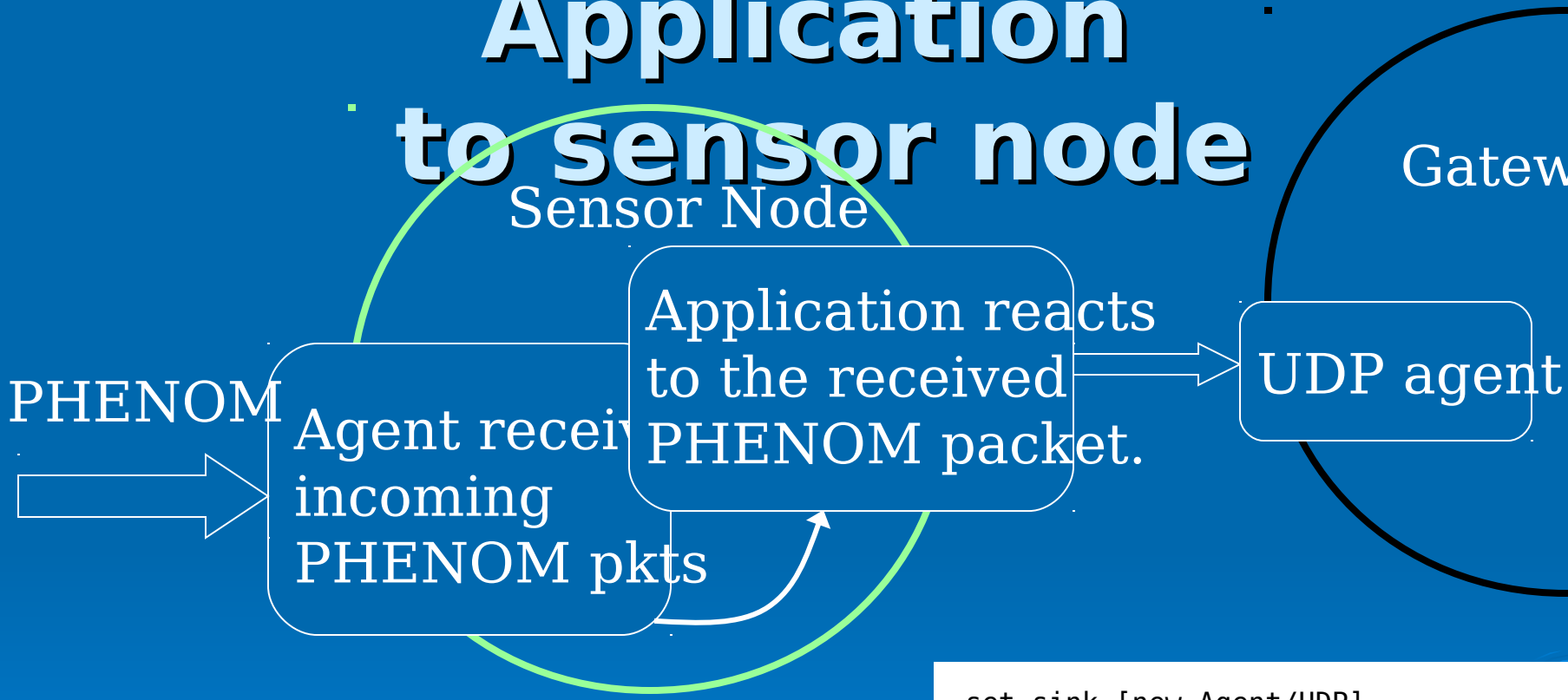


Attach sensor Agent to sensor node




```
set sensor_($i) [new Agent/SensorAgent]
$ns_ attach-agent $node_($i) $sensor_($i)
[$node_($i) set ll_(1)] up-target $sensor_($i)
```

Attach sensor Application to sensor node




```
set sink [new Agent/UDP]
$ns_ attach-agent $node_(2) $sink
set src_node [new Agent/UDP]
$ns_ attach-agent $node_(1) $src_node
$ns_ connect $src_node $sink
set app_ [new Application/SensorApp]
$app_ attach-agent $src_node
```

Start Applications

- Phenom nodes automatically start at t=0
  - Setting transmit power (“set Pt_ 0.0000”) effectively deactivates phenomenon
- Start sensor application with:

```
$ns_ at 5.0 "$app_($i) start $sensor_($i)"
```

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Now run ns!

Bugs and Problems

- Too many nuances involved in setting up simulations
- Unpredictable segmentation faults (NRLOLSR)
- Ns2 errors hard to interpret
- Sensor network model had not been qualitatively validated
  - Particularly concerned with energy model
- Patching ns2 requires many modifications in its source code

Future Work

1. Investigate routing protocol tradeoffs for sensor networks
2. Reduce vulnerability to seg. faults
3. Release code to ns2 community
4. Improve the propagation model for phenomena